


### Auction at a High Level

- Selection
- Ranking
- Pricing
- Auction adjustments
- 1p auction
- Risk


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## Ads Selection

- Ads can match on:
  - Contextual
    - Keyword, site, topic/vertical, etc.
  - User
    - Demographic, in-market, user list, etc.
  - Auto-targeting
    - We select targeting based on performance


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## Ads Selection

- Adgroup server:
  - Indexed: millions of ads
  - Match: thousands
  - Shard auction: hundreds
  - Return to auction: tens
- Shard auction runs to approximate mixer auction
  - Simpler models for pctr, pcvr, etc.


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## Ads Selection - low identity

- What if we don't have user signals?
  - Contextual fallbacks
    - Map from contextual signals to demographic/audience (e.g. generalize from where we do have cookies)
  - More auto-targeting
  - Broader contextual matching
  - Increase signed-in users
    - E.g. pubs SSO through Google


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## GDN Auction Ranking

- Advertisers can pay per
  - Click
  - Conversion
  - Engagement
  - Active View
  - TrueView (video)
- Convert all bids to maxEcpm (max expected cost per 1000 imps)
  - e.g.  $1000 * \text{maxCpc} * \text{pCTR}$
- maxEcpm lets us compare ads in the same space

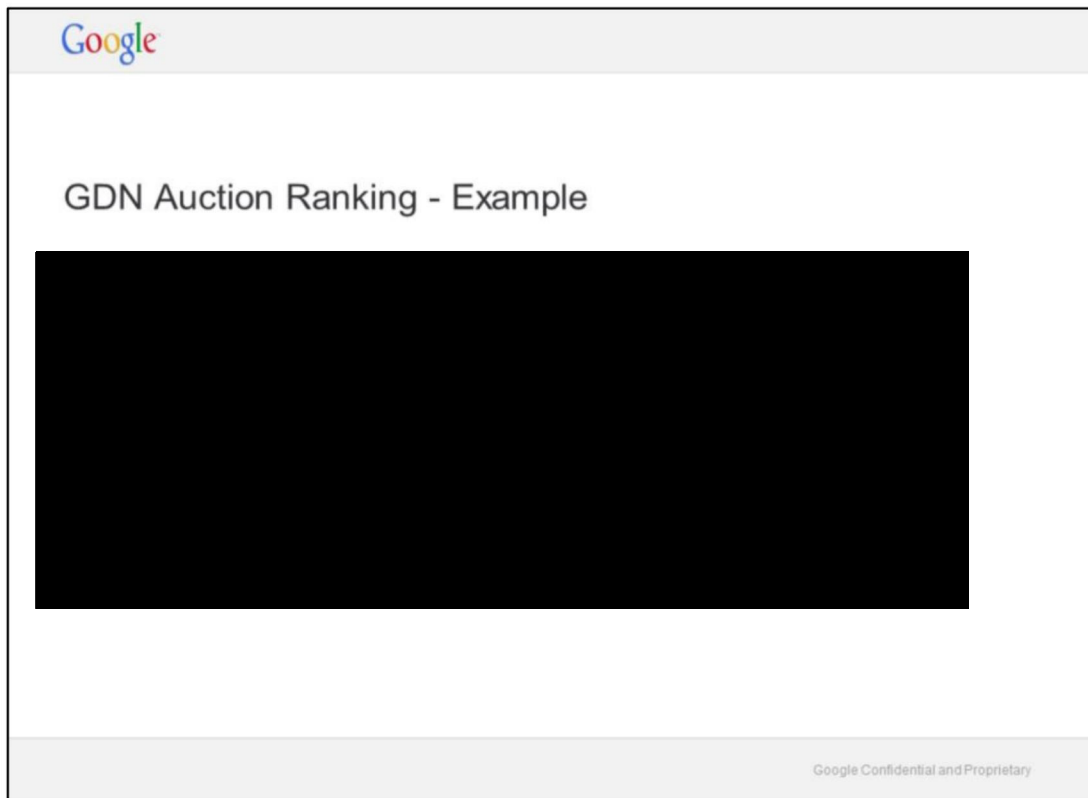
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## GDN Auction Ranking

- We have auction ranking scores for each ad BUT we need to pick the best **configuration** of ads...
- Dynamic resizing within non-full-slot auction
  - N ads requested; can we do better by showing <N?

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## GDN Auction Pricing

- Second price (single ad)
  - Pick highest maxEcpm, use second highest to set price of winner
- VCG (Vickrey-Clarke-Groves) pricing
  - Generalization of second pricing (e.g. multiple ads)
  - Remains a truthful pricing mechanism
  - Prices auction winners according to counterfactual: how much does the winning ad cost other ads by participating the auction?
- Dynamic resizing and VCG matter for multiple ads
  - Currently we show 1 ad vast majority of queries
  - However this is becoming important again with formats such as video pods

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## Auction Adjustments

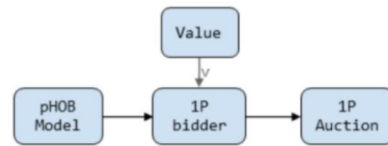
- GDN auction score is a function of maxEcpm and other adjustments
  - Fees (e.g. 3p data)
  - Quality adjustment
    - Fixed fee (additive) - e.g. mute-based fees
    - Auction score multiplier
- Problem with adjustments: inconsistency across stack
  - Shard auction may not return best set of ads
  - Combined auction is pure CPM
    - Quality adjustments hurt GDN competitiveness
- We are trying to move toward pure ecpm

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## First price auctions - computing bid

- Objective: Max expected surplus or profit
  - surplus = value - bid if won
- Ingredients:
  - Value or  $E[\text{value}]$ : This is what we bid in 2P auctions
  - Predict competition aka Highest Other Bid (HOB)
- Optimal bid
  - Maximizes  $E[\text{surplus}]$
  - Function of value and  $CDF_{HOB}$

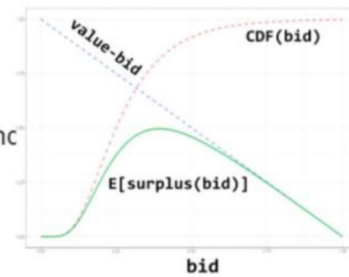


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## How to compute 1st price bid?

- Objective
  - $E[\text{surplus}(\text{bid})] = (\text{value} - \text{bid}) * P_{\text{win}}(\text{bid})$
  - $P_{\text{win}}(\text{bid}) = P(\text{HOB} < \text{bid}) = \text{CDF}_{\text{HOB}}(\text{bid})$
  - Product of two curves (decreasing and inc)
- Optimal bid
  - Maximizes  $E[\text{surplus}]$
  - Function of value and  $\text{CDF}_{\text{HOB}}$

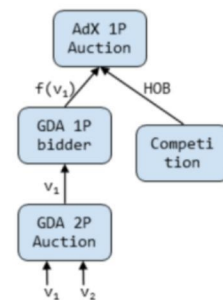


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## Preserving incentive compatibility [go/gda-1p-bidder-advertiser-incentive](https://www.google.com/go/gda-1p-bidder-advertiser-incentive)

- Most spend on GDA is from auto bidding
- Auto bidding products designed in 2P world
- Incentive compatibility is critical to keep them working
- GDA internal auction stays 2P
  - $v_1$ : value of GDA winning ad
  - $v_2$ : value of GDA runner up
- Winner charged min value to win query
  - Win internal auction:  $v > v_2$
  - Win AdX auction  $f(v, ..) > HOB \Rightarrow v > f^{-1}(HOB)$
  - Cost =  $\max(v_2, f^{-1}(HOB, ..))$



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## Risk

- Charge advertisers on click but pay pubs on impression
  - Risk: what if we mispredict?
  - Opportunity: arbitrage (dynamic margins, Bernanke)
- How to mitigate risk?
  - Revenue calibration: measure  $e\text{Revenue}/\text{Revenue}$ , adjust bids to correct
  - Shield: detect and react to tail risks (large misprediction for particular advertisers/publishers)

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## Future Work

- Launch 1p smart bidder on apps (currently using bid translation)
  - Additional challenges in apps:
    - HOB inaccuracy due to mediation chains
    - On-platform competitiveness vs off-platform
- Combinatorial auction at combined auction level (GDN, DBM, RTB)
  - Video pods
  - SRA
  - Multi-ad UI (MAUI)

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## Achieving GDA margins

- GDA: Aggregate margin of 15%
- Surplus maximization + Incentive compatible pricing => margin ??
- Revenue: charge advertiser  $\max(f^1(\text{HOB}), v_2)$
- Payout: pay publisher first-price bid

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## How does ads UI affect pctr/auction?

- Choice of rendering/UI affects pctr and position normalizers
  - May change tradeoff between text and full-slot sub-auction
  - May change optimal dynamic resizing decision
- UI normalizers as generalization of position normalizers
- UI versions are a feature in the model
  - feature is a fingerprint of repeated (key, value) pairs
  - e.g. key = RENDERING\_STYLE, value = {SIMPLE\_UI, MAGAZINE, CAROUSEL, ...}

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### How does rendering affect pctr/auction?

- Experiment with changing the UI?
  - Send the new UI in the request, let the model predict on it
- Experiment with multiple UIs?
  - Send multiple UIs in the request, model predicts position normalizers for all of them, auction chooses the best

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